This key should allow you to understand why you choose the option you did (beyond just getting a question right or wrong). More instructions on how to use this key can be found here.

If you have a suggestion to make the keys better, please fill out the short survey here.

Note: This key is auto-generated and may contain issues and/or errors. The keys are reviewed after each exam to ensure grading is done accurately. If there are issues (like duplicate options), they are noted in the offline gradebook. The keys are a work-in-progress to give students as many resources to improve as possible.

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1. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(8 + 2i)(-9 + 7i)$$

The solution is $-86 + 38i$, which is option E.

A. $a \in [-59, -55]$ and $b \in [-78, -72]$

$-58 - 74i$, which corresponds to adding a minus sign in the second term.

B. $a \in [-73, -63]$ and $b \in [11, 16]$

$-72 + 14i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

C. $a \in [-87, -85]$ and $b \in [-44, -36]$

$-86 - 38i$, which corresponds to adding a minus sign in both terms.

D. $a \in [-59, -55]$ and $b \in [74, 77]$

$-58 + 74i$, which corresponds to adding a minus sign in the first term.

E. $a \in [-87, -85]$ and $b \in [34, 41]$

* $-86 + 38i$, which is the correct option.

General Comment: You can treat i as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

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2. Simplify the expression below and choose the interval the simplification is contained within.

$$3 - 2^2 + 1 \div 10 * 18 \div 11$$

The solution is -0.836, which is option D.

A. $[-1.12, -0.9]$

-0.999, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

B. $[7.09, 7.26]$

7.164, which corresponds to an Order of Operations error: multiplying by negative before squaring. For example: $(-3)^2 \neq -3^2$

C. $[6.71, 7.11]$

7.001, which corresponds to two Order of Operations errors.

D. $[-0.85, -0.3]$

* -0.836, this is the correct option

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

General Comment: While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

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3. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\sqrt{\frac{1188}{9}} + \sqrt{45}i$$

The solution is Nonreal Complex, which is option B.

A. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3 + 5)

B. Nonreal Complex

* This is the correct option!

C. Pure Imaginary

This is a Complex number $(a + bi)$ that **only** has an imaginary part like $2i$.

D. Not a Complex Number

This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number!

E. Irrational

These cannot be written as a fraction of Integers. Remember: π is not an Integer!

General Comment: Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

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4. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\sqrt{\frac{625}{0}} + \sqrt{45}i$$

The solution is Not a Complex Number, which is option D.

A. Irrational

These cannot be written as a fraction of Integers. Remember: π is not an Integer!

B. Pure Imaginary

This is a Complex number $(a + bi)$ that **only** has an imaginary part like $2i$.

C. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3 + 5)

D. Not a Complex Number

* This is the correct option!

E. Nonreal Complex

This is a Complex number $(a + bi)$ that is not Real (has i as part of the number).

General Comment: Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

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5. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{-9 - 33i}{-7 + 5i}$$

The solution is $-1.38 + 3.73i$, which is option B.

A. $a \in [-103.5, -101]$ and $b \in [3, 4.5]$

$-102.00 + 3.73i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

B. $a \in [-3, -1]$ and $b \in [3, 4.5]$

* $-1.38 + 3.73i$, which is the correct option.

C. $a \in [-3, -1]$ and $b \in [275.5, 276.5]$

$-1.38 + 276.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

D. $a \in [1.5, 4]$ and $b \in [2, 3]$

$3.08 + 2.51i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

E. $a \in [0.5, 1.5]$ and $b \in [-8, -6.5]$

$1.29 - 6.60i$, which corresponds to just dividing the first term by the first term and the second by the second.

General Comment: Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.

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6. Simplify the expression below and choose the interval the simplification is contained within.

$$6 - 3^2 + 19 \div 5 * 10 \div 2$$

The solution is 16.000, which is option B.

A. $[33.31, 34.53]$

34.000, which corresponds to an Order of Operations error: multiplying by negative before squaring. For example: $(-3)^2 \neq -3^2$

B. $[15.92, 16.33]$

* 16.000, this is the correct option

C. $[14.78, 15.26]$

15.190, which corresponds to two Order of Operations errors.

D. $[-2.93, -1.92]$

-2.810, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

General Comment: While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

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7. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(-7 - 8i)(3 + 10i)$$

The solution is $59 - 94i$, which is option B.

A. $a \in [56, 63]$ and $b \in [93, 97]$

$59 + 94i$, which corresponds to adding a minus sign in both terms.

B. $a \in [56, 63]$ and $b \in [-96, -92]$

* $59 - 94i$, which is the correct option.

C. $a \in [-103, -100]$ and $b \in [-46, -40]$

$-101 - 46i$, which corresponds to adding a minus sign in the first term.

D. $a \in [-24, -16]$ and $b \in [-85, -73]$

$-21-80i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

E. $a \in [-103, -100]$ and $b \in [46, 47]$

$-101 + 46i$, which corresponds to adding a minus sign in the second term.

General Comment: You can treat i as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

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8. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{-72 - 66i}{3 + 4i}$$

The solution is $-19.20 + 3.60i$, which is option C.

A. $a \in [-25, -23.5]$ and $b \in [-17.5, -15.5]$

$-24.00 - 16.50i$, which corresponds to just dividing the first term by the first term and the second by the second.

B. $a \in [-20.5, -19]$ and $b \in [89.5, 91]$

$-19.20 + 90.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

C. $a \in [-20.5, -19]$ and $b \in [3, 5]$

* $-19.20 + 3.60i$, which is the correct option.

D. $a \in [1.5, 2]$ and $b \in [-20, -19]$

$1.92 - 19.44i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

E. $a \in [-481, -479]$ and $b \in [3, 5]$

$-480.00 + 3.60i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

General Comment: Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2+3i$, the conjugate is $2-3i$.

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9. Choose the **smallest** set of Real numbers that the number below belongs to.

$$\sqrt{\frac{23}{0}}$$

The solution is Not a Real number, which is option A.

A. Not a Real number

* This is the correct option!

B. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

C. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3)

D. Irrational

These cannot be written as a fraction of Integers.

E. Integer

These are the negative and positive counting numbers (..., -3, -2, -1, 0, 1, 2, 3, ...)

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $\sqrt{\frac{23}{0}}$.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.

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10. Choose the **smallest** set of Real numbers that the number below belongs to.

$$-\sqrt{\frac{256}{625}}$$

The solution is Rational, which is option B.

A. Integer

These are the negative and positive counting numbers (..., -3, -2, -1, 0, 1, 2, 3, ...)

B. Rational

* This is the correct option!

C. Not a Real number

These are Nonreal Complex numbers **OR** things that are not numbers (e.g., dividing by 0).

D. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

E. Irrational

These cannot be written as a fraction of Integers.

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $-\frac{16}{25}$.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.